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Original Article

EFFECT OF *CURCUMA LONGA* L. RHIZOME DECOCT ON GLUCOSE ABSORPTION LEVEL IN INTESTINE OF MALE RAT OF WISTAR STRAIN

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ABSTRACT

Objective: Glucose is a source of energy. Its level in blood depends on the absorption in the digestive tract. The aim of this research is to evaluate the effect of *Curcuma longa* L. rhizome decoct on the glucose absorption in intestine of male rat.

Methods: The mixture of 30 mM glucose in 0.9 % sodium chloride solution as a control solution. Decoct was made at the dose 145 mg/kg BW of rat with control solution as a solvent. The rat was put under anaesthetia by urethane. The control solution was given to the rat via perfusion for 1 hour. Then, it is followed by decoct for 1 hour. Every 15 minutes the glucose solution concentration was measured by enzymatic method. The decrease of glucose solution concentration is similar to the absorption level of glucose solution by the intestine.

Results: The levels of glucose absorption of control and decoct were 76.52 % and 72.76 %, respectively. The difference of both were significant ($p<0.02$).

Conclusion: the decoct of *Curcuma longa* L. at 145 mg/kg bw of rat has a significant effect ($p<0.02$) to decrease the glucose absorption level in the intestine. Therefore decoct had a good effect to reduce blood glucose level.

Keyword: *Curcuma longa* L., decoct of *Curcuma longa* L., glucose absorption in intestine rat.

INTRODUCTION

In Indonesia the rhizome of *Curcuma longa* (turmeric) is widely used as a spice and coloring agent in many foods e.g. as yellow rice for breakfast in Sundanese, Bagana rice as a serving in children birthday party, etc. Beside that turmeric is often combined with tamarind (*Tamarindus indica*) as Jamu (*Kunyit-asam*, traditional medicine), and is commonly sold on the street by Jamu hawkers. Nowadays, it is produced as soft drink and is distributed in Indonesia. Turmeric as a traditional medicine has been used as a remedy for the treatment of fever, colds, diarrhea, rheumatic, jaundice, amenorrhea, hyperlipidemia, dyspepsia, etc [1]. After many research on turmeric have proved that it had the positive effects for health. Nowadays consumption of turmeric has been associated with various beneficial effects on human health. The effects which were published are: 6 g *C. longa* had significant effect to increase postprandial serum insulin levels, therefore suggested it may had an effect on insulin secretion, but had no significant effect on the plasma glucose response or glycemic index [2].

In a study involving induced diabetic rats with streptozotocin, the rats were given, curcumin at doses 50 and 300 mg/kg, and it found that it had effect to restore glycemic indices, increased the activity of pancreatic G6PDH and level of GSH. Both doses improved the architecture of pancreas, decreased MDA, and caspase-3 content, too. Therefore curcumin was suggested as having a palliative effect on Diabetes mellitus [3]. In other studies curcumin increased the glucose transport from jejunal and upper ileal portion of small intestine, therefore suggesting that it influence the nutrients transport from the gut [4]. Curcumin at a dose of 1 gm/kg body weight suggested: decreased intestinal motility of albino rats [5], and has activity to decrease the gastric emptying [6]. Oral curcumin at doses of 400 mg/rats (2 g/kg-bw) single dose once a week, "significantly reduces atrophy of soleus muscle in rats immobilized for 2 weeks" [7].

Decoct of 3.98 g of dried rhizome of *Curcuma longa* has antioxidant activity with 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay, EC_{50} is 18.4 µg/ml [8]. The aqueous *Curcuma longa* extract which was produced by maceration has activity against endodontic pathogen. 500 g of *Curcuma longa* was produced 19.5 g of the semi-solid aqueous extract. The tested extract was prepared in DMSO (dimethyl sulfoxide). 0.75% concentration showed the greatest zone of inhibition (13 mm) against *Staphylococcus aureus* and 50% concentration showed the best zone of inhibition (15.66 mm) against *Candida albicans* and mild inhibiting activity (a zone inhibition of 9 mm) against *Enterococcus faecalis* [9]. Modern in vitro studies showed that turmeric is a potent antioxidant, antimicrobial, antimutagenic, anti-inflammatory, and anticancer agent. "As an antioxidant, turmeric extracts can scavenge free radicals, increase antioxidant enzymes, and inhibit lipid peroxidation. Using *Salmonella typhimurium* strains TA 100 and TA 1535, a mutagenicity study showed that turmeric inhibits the mutagenicity produced by direct-acting mutagens such as N-methyl N'-nitro-N-nitroso guanidine and sodium azide. Turmeric extracts were found to inhibit microsomal activation-dependent mutagenicity of 2-acetamidofluorene". *In vivo* studies both the preventive and therapeutic effects were reported that this yellow spice exhibits anticancer, hepatoprotective, cardioprotective, hypoglycemic, and antiarthritic properties" [10]. The curcumin derivatives which was produced by docking and modeling had activity against the infection of influenza (H1N1) virus [11]. Arun et al. researched about formulation of curcumin in order to enhance the dissolution rate. The result is ternary solid dispersion (third generation solid dispersion) enchance the dissolution rate than binary solid dispersion [12]. "There are more than 100 phytoconstituents isolated from turmeric. The main component of the root is a volatile oil, containing turmerone, and there are other coloring agents called curcuminoids in turmeric. Curcuminoids consist of curcumin demethoxycurcumin, 5'-methoxycurcumin, and dihydrocurcumin, which are found to be natural antioxidants. Volatile oils include d-α-phellandrene, d-sabinene, cinol, borneol, zingiberene, and sesquiterpenes. There are a variety of sesquiterpenes, like germacrone; termerone; ar-(+)-, α-, and β-termerones; β-bisabolene; α-curcumene; zingiberene; β-sesquiphellanderene; bisacurone; curcumenone; dehydrocurdione; procurcumadiol; bis-acumol; curcumenol; isoprocurcumenol; epiprocurcumenol; procurcumenol; zedoaronediol; and curlone, many of which are specific for a species. The components responsible for the aroma of turmeric are

turmerone, arturmerone, and zingiberene. The rhizomes are also reported to contain four new polysaccharides-ukonans along with stigmasterole, β-sitosterole, cholesterol, and 2-hydroxymethyl anthraquinone. Turmeric is also a good source of the ω-3 fatty acid and α-linolenic acid (2.5%)" [10]. In other research "fresh turmeric rhizomes and leaves contained 0.36% and 0.53% of oils (w/v) respectively by steam distillation. By GC and GC-MS analysis, it was found that 73 of the constituents in rhizomes were 95.2% of oil, of which the major ones were ar-turmerone (31.7%), α-turmerone (12.9%), β-turmerone (12.0%) and (Z) β-ocimene (5.5%). The oils contain 75 constituents these were 77.5% of the oils were identified, the major ones were α-phellantrene (9.1%), terpinolene (8.8%), 1,8-cinceole (7.3%), undecanol (7.1) and p-cymene (5.5%)" [13]. The Soedigdo in situ perfusion method with Wistar rats was used to measurement of inhibiting of Pangamic acid on the transport of glucose in rat intestine [14]. The decoct of *Curcuma xanthorrhiza* Roxb. at 160 mg/kg bw of rat showed the inhibition effect on the glucose absorption level on intestine, although is not significant [15]. Base on its effects as mentioned above, it is widely used in yellow rice a kind of traditional Indonesian breakfast made from rice, Bagana rice, jamu (traditional medicine), etc. This study was done to evaluate the effect of decoct of C*urcuma longa* rhizome on the glucose absorption in intestine of male rat at the minimal dose in traditional medicine due to the fact that tumeric is often incorporated into preparation of rice meals and rice being a source of energy in the form of carbohydrates. The digestion of carbohydrates will yeild glucose as the end prodcut.

MATERIAL AND METHODS

Sample

Curcuma longa L. rhizome from Cicalengka (West Java):

Reagent: sodium chloride (E.Merck), glucose, glucose test reagent (St. Reagensia), trichloroacetic acid precipitation of protein (TCA) 8% (St. Reagensia), urethane (E.Merck).

Equipment: Perfusion equipment was designed by P. Soedigdo and Marsongkohadi, glass equipment, decoct equipment, surgery equipment, micro pipette (CAPP), micro tube, syringe with needle (5 ml and 10 ml), balance (Sartorius 2442), spectrophotometer (Spectronic 20 Genesys)

Preparation of C*urcuma longa* L. rhizome decoct (as test solution).

C*urcuma longa* rhizome was harvested in December 2010. It, has diameter 2.2 – 2.5 cm; wet weight = 59.97 g, dried weight = 4,86 g.

Dosage of fresh C*urcuma longa* rhizome was 2 fingers/day, is 20 – 50 g/day [1].

The minimum traditional dosage for people was 20 g of wet C*urcuma longa* rhizome = $\frac{20}{59.97} \times 4.86$ g = 1.6208 g dried rhizome.

Rat dose (bw = 200 g) = $\frac{1}{56} \times 1.6208$ g = 0.0289 g = 29 mg dried rhizome or 145 mg/kg bw of rat.

Decoct of dried C*urcuma longa* L. rhizome was made with the dosage 145 mg/kg bw of rat in the

100 ml of mixture 30 mM glucose in 0.9 % sodium chloride solution.

The of decoct was prepared by boiling 116 mg of dried rhizome in 400 ml mixture of 30 mM glucose in 0.9 % sodium chloride solution at 90^0C for 30 minutes, and finally water was added in decoct until the volume was 400 ml.

Table 1: The absorption of glucose levels by rat intestine from glucose solution (control)

No. Rat	Body weight (g)	Time of absorption of glucose	Glucose level (%)	
			Unabsorption	Absorption
1	175	15'	36.43	63.57
		30'	30.23	69.77
		45'	26.36	73.64
		60'	25.58	74.42
		Average	29.65	70.35
2	183	15'	36.12	63.88
		30'	20.56	79.44
		45'	16.59	83.41
		60'	10.96	89.04
		Average	21.06	78.94
3	172	15'	32.12	67.88
		30'	30.26	69.74
		45'	26.14	73.86
		60'	18.60	81.40
		Average	26.78	73.22
4	185	15'	19.30	80.70
		30'	18.61	81.39
		45'	18.61	81.39
		60'	13.95	86.05
		Average	17.62	82.38
5	183	15'	32.56	67.44
		30'	19.30	80.70
		45'	18.60	81.40
		60'	18.60	81.40
		Average	22.27	77.73

The absorption of glucose levels by rat intestine from glucose solution (control) was: 70.35; 73.22; 77.73; 78.94; and 82.38%

Preparation of 3 x 10^{-3} M glucose solution in the 0.9% sodium chloride solution (as control solution)

The amount of 0.0059 g of glucose made a solution in 100 ml of 0.9% sodium chloride solution[15].

Urethan solution for a rat (200 g) : Anaesthetic solution was made with dissolved 0.2800 g of urethan in 2 ml water for injection" [15].

Procedure

The method of the study was approved by the Committee of Animal Ethics of Faculty of Medicine, Universitas Kristen Maranatha – R.S.Immanuel on 26 February 2011.

Urethane was injected (IP) for anaesthetized of rat, abdomen of rat was opened and perfusion instrument was put in at the intestine

which both was linked by two bent pipettes, the first pipette is 10 cm from the pylorus, the second pipette is 25 cm from the first pipette.

Firstly, the intestine was cleaned by 0.9% sodium chloride solution, then the control solution was circulated in the intestine for fourth times circulation per minutes. The glucose levels in the control solution were measured every 15 minutes for one hour. After one hour the control solution was thrown out from the intestine, and the intestine was cleaned again by 0.9% sodium chloride solution. The above procedure was repeated by replacing the decoct solution. The glucose levels in the decoct solution were measured every 15 minutes for one hour [14,15].

The result of the glucose absorption level by intestine of rats

"The unabsorpted glucose levels were measured by spectrophotometer at a wavelength 505 nm, and the absorption of glucose levels were calculated from the unabsorption of glucose levels by the equation: the glucose level absorption = (100 – the glucose level unabsorption) (%)" [14,15].

Both of the glucose levels from control solution and test solution were statistically analyzed with Student T test.

Student T test between the difference of the glucose levels from glucose solution (control) (76.52%) and decoct of C*urcuma longa* rhizome (72.76%) are significant (P < 0.02).

RESULTS AND DISCUSSION

Base on the observed data, C*urcuma longa* rhizome decoct at dose of 145 mg/kg bw of rat has significant effect in decreasing the glucose absorption. This fact showed the minimal dose of C*urcuma longa* rhizome in traditional medicine can reduce the absorption of glucose by intestine of rat.

Table 2: The absorption of glucose levels by rat intestine from decoct of *Curcuma longa* rhizome

No. Rat	Body weight (g)	Time of absorption of glucose	Glucose level (%)	
			Unabsorption	Absorption
1	175	15'	41.86	58.14
		30'	32.56	67.44
		45'	27.91	72.09
		60'	27.91	72.09
		Average	32.56	67.44
2	183	15'	30.23	69.77
		30'	24.03	75.97
		45'	20.93	79.07
		60'	19.38	80.62
		Average	23.64	76.36
3	172	15'	48.84	51.16
		30'	34.81	65.19
		45'	24.03	75.97
		60'	20.16	79.84
		Average	31.96	68.04
4	185	15'	24.04	75.96
		30'	20.93	79.07
		45'	19.38	80.62
		60'	16.28	83.72
		Average	20.16	79.84
5	183	15'	40.17	59.83
		30'	38.84	61.16
		45'	18.60	81.40
		60'	13.95	86.05
		Average	27.89	72.11

The absorption of glucose levels by rat intestine from C*urcuma longa* rhizome decoct was: 67.44; 68.04; 72.11; 76.36; and 79.84%.

Table 3: The absorption of glucose levels by rat intestine from glucose solution (control) and decoct of *Curcuma longa* rhizome

No. of sample	Absorption of glucose levels (%)	
	Control Solution	decoct of *Curcuma longa* rhizome
1	70.35	67.44
2	73.22	68.04
3	77.73	72.11
4	78.94	76.36
5	82.38	79.84
Mean ± SEM	76.52 ± 2.13	72.76 ± 2.39

CONCLUSION

Conclusion, the decoct of *Curcuma longa* L. at 145 mg/kg bw of rat has significant effect ($p<0.02$) to decrease the glucose absorption level in intestine. Therefore decoct had good effect to reduce blood glucose level.

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